

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY**BE – SEMESTER- V EXAMINATION-SUMMER 2023****Subject Code: 3151605****Date: 26/06/2023****Subject Name: Formal Language and Automata Theory****Time: 02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

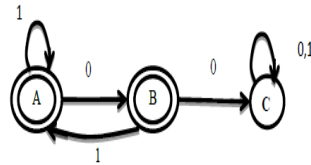
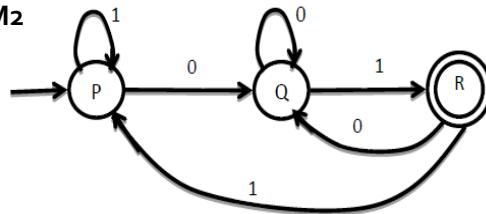
- Q.1** (a) Define Finite Automata and Pushdown Automata. **03**
 (b) What is ambiguous grammar? Does $S \rightarrow aSbS \mid bSaS \mid \epsilon$ ambiguous? **04**
 (c) List out the steps involved in pumping lemma for regular language. Prove that $L = \{a^n b^n, n \geq 0\}$ is a non-regular language using pumping lemma. **07**

- Q.2** (a) Define Context Free Grammar (CFG) with example. **03**
 (b) I. Write CFG which contains at least three times 1 **04**
 II. Write CFG that must start and end with same symbol
 (c) Convert given NFA into an equivalent FA using subset construction method. **07**

δ	Input	
State	0	1
q_0	$\{q_0\}$	$\{q_0, q_1\}$
q_1	$\{q_2\}$	$\{q_2\}$
q_2	$\{q_3\}$	$\{q_3\}$
q_3	$\emptyset$	$\emptyset$

OR

- (c) Draw the Finite Automata recognizing the languages: $L_1 \cup L_2$, $L_1 \cap L_2$ and $L_1 - L_2$. **07**

M1**M2**

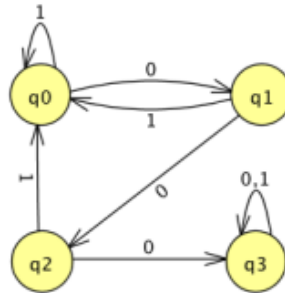
- Q.3** (a) Differentiate Finite Automata vs. Pushdown Automata **03**
 (b) Given a CFG, $G = (\{S, A, B\}, \{0, 1\}, P, S)$ with P as follows:
 $S \rightarrow 0B \mid 1A$
 $A \rightarrow 0S \mid 1AA \mid 0$
 $B \rightarrow 1S \mid 0BB \mid 1$ **04**

Convert it into an equivalent Pushdown Automata (PDA).

- (c) Design a Pushdown Automata (PDA) for $L = \{a^n b^{2n} \mid n \geq 0\}$. **07**

OR

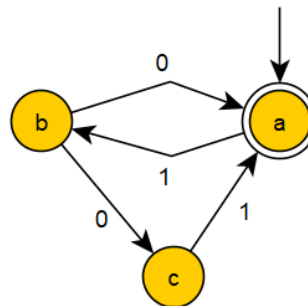
- Q.3 (a)** Perform leftmost derivation and draw parse tree. **03**
 $S \rightarrow A1B$
 $A \rightarrow 0A \mid \epsilon$
 $B \rightarrow 0B \mid 1B \mid \epsilon$
 Output string: 1001
- (b)** Using Extended Transition Function δ^* for FA $\{\{q_0, q_1, q_2, q_3\}, \{0, 1\}, \{q_0\}, \{q_3\}, \delta\}$. Calculate $\delta^*(q_0, 1010010001)$. **04**



- (c)** Design a Pushdown Automata (PDA) for $L = \{a^n b^{n+m} c^m \mid n, m \geq 1\}$. **07**

OR

- Q.4 (a)** Write a note on Chomsky Hierarchy. **03**
(b) Using recursive definition of δ^* in NFA, check acceptability of string 101010 over $\Sigma = \{0, 1\}$. **04**



- (c)** Design a TM for accepting palindrome strings of even & odd length. **07**

OR

- Q.4 (a)** Differentiate Recursively Enumerable Language vs. Recursive Language. **03**
(b) Write short note on Universal Turing Machine. **04**
(c) Write a Turing Machine to delete a symbol from tape head position from given string. **07**

- Q.5 (a)** Show that function $f(x, y) = x + y$ is primitive recursive. **03**
(b) Convert given Context Free Grammar (CFG) to an equivalent Chomsky's Normal Form (CNF). **04**

$S \rightarrow aAbB$

$A \rightarrow Ab \mid b$

$B \rightarrow Ba \mid a$

- (c)** Prove that If L_1 and L_2 are context - free languages, then the languages $L_1 \cup L_2$, $L_1 \cap L_2$, and L_1^* are also CFLs. **07**

OR

- Q.5 (a)** What are Primitive Recursive Functions? **03**
(b) Explain Post correspondence problem with example. **04**

(c) Convert given NFA- Λ to an equivalent FA.

07

q	$\delta(q, \wedge)$	$\delta(q, 0)$	$\delta(q, 1)$
A	{B}	{A}	ϕ
B	{D}	{C}	ϕ
C	ϕ	ϕ	{B}
D	ϕ	{D}	ϕ
